UNITED STATES DEPARTMENT OF AGRICULTURE
Rural Electrification Administration

BULLETIN 1724D-101B

SUBJECT: System Planning Guide, Construction Work Plans

TO: REA Electric Borrowers and REA Electric Staff

EFFECTIVE DATE: Date of Approval

EXPIRATION DATE: Three years from effective date

OFFICE OF PRIMARY INTEREST: Distribution Branch, Electric Staff Division

FILING INSTRUCTIONS: This Bulletin supersedes Bulletin 60-10, "Construction Work Plans, Electric Distribution Systems", dated December 20, 1967. Replace Bulletin 60-10, dated December 20, 1967, with this bulletin. File along with 7 CFR 1724 in the blue binders.

PURPOSE: The purpose of this bulletin is to provide guidance to borrowers and engineers for the preparation, use, and approval of construction work plans (CWPs) for electric distribution systems.
CWPs are used as an engineering support document for a loan application, as a component of an ongoing integrated planning system, and specifies and documents plant requirements for the short term, 2 to 3 years.

James B. Huff, Sr. — 4/14/93
Administrator — Date

TABLE OF CONTENTS

ABBREVIATIONS

BER	Borrowers Environmental Report
CFR	Code of Federal Regulations
CWP	Construction Work Plan
GFR	General Field Representative
LRP	Long-Range Plan
O & M	Operations and Maintenance
OCR	Oil Circuit Recloser
PRS	Power Requirements Study
SCADA	Supervisory Control and Data Acquisition

1. Use of CWP and Model: The CWP process is used to determine and document the most feasible, environmentally acceptable and economical construction required during the planning period, (usually two years), which is needed to provide adequate and reliable electric service to all of the system's new and existing members. The CWP report is a valuable reference for the preparation of annual construction budgets and schedules. The CWP report is also used as an engineering support document for a loan application to finance the proposed construction program. As such, the report is used as a means to inform REA and receive REA's approval of proposed new construction items.

1.1 Appended to this bulletin is a sample or "model" construction work plan report. The purpose of this model CWP is to illustrate exhibits, such as narratives and tables, which are considered to have form and content acceptable to describe, justify and/or summarize proposed construction items. The types of examples in the model are also used to explain and demonstrate some basic activities which are considered to be essential in the planning process. The Model CWP is comprised of a collection of exhibits, which have been modified to apply to a small, fictitious, distribution system. Thus, there is no consistent direct correlation among the exhibits. Hereafter, references to specific exhibits in the model CWP will be made with the use of brackets; e.g. [see II-E3]

1.2 The use of this model CWP and its contents, appropriately modified, is suggested but not required.

2. Preparation: Usually, the first step in the CWP process involves a meeting among the system management, the system's staff or consulting engineer, and the REA General Field Representative (GFR). Agreement should be reached on the new CWP's planning period, projected maximum loads and number of consumers, and other technical items as discussed below. At this time agreement should also be reached on dates and type of data to be furnished to the engineer, the target completion date of the CWP study, and future coordination and CWP draft review meetings.

2.1 Next, the following data and studies need to be reviewed, analyzed and updated:

2.1.1 Historical system data such as energy purchases and sales, losses, peak kW demands, number of consumers, etc. is

generally included in the CWP report for reference information only but not used in the CWP analysis. [see II-E1]

2.1.2 The design criteria are the standards within which the system must perform. They are the basis of defining problems on the system and providing justification for necessary improvements. The design criteria should address all aspects of the system that is to be analyzed. They should be documented and included in the CWP report [see II-A]. The design criteria should be agreed upon by the system management, engineer and GFR before the CWP study begins.

2.1.3 The system's currently approved Power Requirements Study (PRS) needs to be reviewed. The projected peak kW loads and number of consumers for the planning period of the CWP comes directly from this PRS. If any other figures other than the PRS projections are used, they must be explained in the CWP [see II-E-1]. No other written analysis of the PRS is deemed necessary for purposes of the CWP.

2.1.4 The system's Long-Range Plan (LRP) needs to be analyzed to ascertain that its bases, (load projections, economic factors, etc.), are still valid for the CWP planning period and its construction recommendations are still required, feasible and economically sound. It is appropriate to include a thorough yet concise written review of the LRP in the CWP including a comparison of the historical versus recent actual or projected loads [see II-D1]. A written summary of the overall recommendations of LRP helps the reader to understand how new recommended construction items conform to the projected development of the system.

2.1.5 The previous construction work plan, and CWP amendments, must be reviewed to determine which projects have been or will be completed and which recommended construction items need to be carried over into the current CWP. Carryover items may need new cost estimates and should be described and justified in the new construction portion of the CWP report. The status of the construction items of the previous CWP can be explained succinctly with a table. [see II-C]

2.1.6 The system's most recent operations and maintenance (O & M) survey with its associated "Review Rating Summary" (REA Form 300), is an important part of the CWP. The O & M survey is used by the engineer to determine deficiencies, such as deteriorated poles, conductors and equipment, excessive outages, poor tree trimming, etc., that do not

meet the design criteria. It is also used to justify the need of new construction items and programs to correct these deficiencies. If the system-wide O & M survey is more than three years old, a new one should be performed before beginning the CWP.

If less than three years old, the O & M survey should be appropriately analyzed and updated to adequately describe the systems present conditions. A concise written analysis of the
O & M survey, results, and recommendations should be contained in the CWP report [see II-D2]. This analysis should contain enough details to explain deficiencies found on the system and the work required to correct them.

2.1.7 All other relevant studies recently performed on the system, such as sectionalizing, system aging, and power factor correction studies should be reviewed in detail and compared to the requirements of the design criteria. If it is determined that there are or will be deficiencies on the system, the study review should be documented and included in the CWP to explain the problems found and the construction required to resolve them. Narratives [see II-D2] and/or tables [see III-E] may be used to explain and justify these required expenditures.

2.1.8 Periodic system data reports, such as substation maintenance reports, mini-max voltmeter readings, etc., should be tabulated and summarized and compared in detail with the design criteria. Like other system studies, if deficiencies are found and/or construction items required, a documented review of the investigation and its results should be in the CWP to explain the problems and justify proposed corrective construction. Narrative explanations and/or tables may be used as necessary. [see II-E4 through II-E6]

2.1.9 All data that is included in the CWP report should be summarized, analyzed and used to assess the system or to explain and/or justify new construction items. Often it is helpful to the reader to include the data analysis and results on or directly following its exhibit in the CWP report. [see II-E5]

2.1.10 The system's outage data, for the previous five years, should be analyzed and summarized in the CWP report. Exhibit
II-E6 shows a summary of service interruptions that has acceptable format, data and major outage explanations. REA guidelines advocate a maximum of five hours outage per consumer per year.

2.1.11 The following maps, data and information need to be gathered, updated, analyzed, tabulated and/or documented, as appropriate. This information is also useful as exhibits in the CWP report to explain required construction items or procedures used.

Maps; System, Key, Circuit, Area, etc.

Computer Programs; Circuit Analysis, Economic Analysis, Economic Conductor Sizing

Line and Equipment Installed Costs; [see II-B]

Historic (and projected) Number, Distance and Costs to:

1. Install new overhead and underground lines, services, transformers and meters; [see III-A]
2. Replace overhead and underground services, transformers and meters; [see III-B]

2.1.12 It is suggested that the engineer interview line workers, warehouse personnel and others who have first hand knowledge of deficiencies on the system or problems with equipment. All reported deficiencies should be corroborated before recommending construction items in the CWP.

3. Determining Construction Requirements: The projected number of new consumers is interpolated from the system's PRS [see II-E1]. This data, and line distances, equipment and cost data from the past several years is used to determine the construction and cost to serve the borrower's new consumers during the CWP planning period. Known new large power members can be added to these totals. [see III-A]

3.1 Likewise, Exhibit III-B shows the number of service drops, transformers and meters and their associated costs, based on historical data, that are required to be replaced in order to maintain adequate service to existing members.

3.2 Projected total system peak demands are also interpolated from the PRS. The totals may be modified, with explanation, to include recently attained new load data. It is left to the engineer to apply appropriate growth and diversity factors to individual circuits and substations so that the total loads are in agreement with the PRS projections. Load tables, which show equipment capacities, projected circuit and substation transformer loads, new load

additions and new construction projects should be included in the CWP [see II-E2 and II-E3] These load tables are also used to determine and show substation equipment which is anticipated to be loaded above the design criteria.

3.3 Each of the system's distribution circuits, updated to include anticipated new loads and circuit changes, should be analyzed at its projected peak load during the planning period. The primary voltage drop at each circuit node, and the thermal loading of the circuit's conductors and equipment, and power factor and load balance, if applicable, should be compared to the design criteria.

3.4 Primary voltage drops calculated by computer programs should be corroborated with actual field measurements which have been adjusted to load levels equal to the computer runs. These field measurements can be obtained from periodic readings of the system's installed volt meters or from voltage and current investigations performed on the system. If calculated and actual, adjusted, measured readings are different, they must be reconciled using good engineering judgment to be valid to justify new construction items. Exhibit II-E6 shows data and a format convenient for showing, comparing and reconciling calculated and measured voltages. See also the note to the design criteria in the Model CWP.

3.5 Each item found that does not comply with the design criteria, should be corrected during the CWP planning period. This includes all problems found during the above substation loading and circuit analysis, problems found in the engineer's review of the system's planning and O & M studies, operating reports, etc., and problems found in studying the power supply system if applicable to the borrower.

3.6 The engineer usually has several options to resolve the existing and anticipated problems that have been found. Most solutions require new construction or equipment replacement. It is expected that the engineer will investigate all of the feasible alternate solutions and make recommendations that are in compliance with the LRP, and are the most economical considering both distribution and power supply system needs together as one system.

3.7 New power supply and delivery construction items and projects, which are to be provided by a utility other than the borrower, must be discussed with and concurred by the power supplier before the recommendation is included in the CWP. Agreement must be reached on the location and amount of new capacity or delivery and the in-service date. [see IV-B]

3.8 See Section I-1, "General Basis of Study" of the Model CWP for additional guidelines for determining system problems and recommended solutions. Exhibit IV-A in the appendix of the Model CWP shows an acceptable engineering economic analysis.

4. The Construction Work Plan Report: The purpose of the CWP report is to describe, justify and summarize the items which have been determined necessary for construction during the work plan period. Justification usually incorporates the need for a system improvement relating to design criteria and the anticipated pertinent improvement in voltage, loading, service reliability, losses and/or economic benefits compared to alternate plans. The contents of the report should contain sufficient facts and details, including maps, graphs and tables, to accomplish these purposes. Narratives should be concise, factual and relevant. It is suggested that any information or data which does not contribute to the stated purpose of the report be omitted.

4.1 The engineer's certification, if applicable, should be similar to the one on the title page of the Model CWP.

4.2. The "Executive Summary" section at the beginning of the CWP report should be short enough to be read within a few minutes and capable of being fully understood without referring to other sections of the report. Its purpose is to briefly describe the CWP analysis and report and summarize the proposed construction program and its cost.

4.2.1 The overall results of the proposed construction program should be near the beginning of the report and worded similar to the one shown in the Model CWP. [see I-A]

4.2.2 A brief description of the borrower, the electric system and the power supplier is desirable. Small maps may help clarify these descriptions.

4.2.3 A complete summary listing of all of the proposed construction items, such as shown with exhibit I-C or using REA Form 340C, "Cost Estimates and Loan Budget for Electric Borrowers", and the total cost of the proposed construction program, should be in the Executive Summary. These items should be numerically coded according to the latest REA guidelines.

4.2.4 A load table showing the results of proposed construction items, [see I-D], exhibits projected circuit and transformer loading and also shows that substation equipment will not be overloaded during the planning period.

4.3 A section of the CWP report, [see Section II], should document historical and projected system data, the design criteria, unit cost estimates and their derivation, and the written analysis of the various system studies and data that the engineer reviewed, prepared and used in performing the systems analysis. In general, this information is used to determine the portions of the system and equipment which do not meet the design criteria, and to formulate a basis for the acceptability and cost estimates of alternate plans to resolve these existing and anticipated problems.

4.4 Another complete section of the CWP report should be used to document the complete proposed construction program. It is suggested that the items in this section be arranged in the same order as found on REA Form 740C. All significant proposed new construction items, groups of items, and system modifications should be adequately described and justified. The narratives, maps, and tables of Section III of the Model CWP show several different types of examples which adequately describe and justify specific construction items.

4.4.1 Transmission line, substation and other supply items, which are not exhibited in the attached Model CWP, can be explained using a form and contents similar to the above examples.

4.4.2 A concise written summary analysis of other, independent system studies, such as O & M, sectionalizing, SCADA, system aging studies, etc., which require capitalized construction items in the CWP, should be included in the report. This analysis should explain the study, its results and the need for new construction [see II-D2]. A copy of the study need not be included in or appended to the CWP report, if a copy has previously been furnished to REA. Otherwise, it should be included in the Appendix. A listing or table of the construction items and their associated cost required as a result of each of the above studies should be placed in the CWP report with the other required construction items. [see III-E & III-H]

4.5 Samples of calculations performed by the engineer, and/or sample printouts of the computer programs used by the engineer, such as engineering economic analysis and distribution circuit analysis, should be included in the Appendix of the CWP report [see IV-A]. It is desirable to include only one or two typical samples of calculations or

printouts. The engineer should retain all pertinent calculations, data, and notes and be able to furnish it to others upon request.

4.5.1 Also in the Appendix of the CWP report should be maps of the system which show, as a minimum, the following information:

a. The borrower's service area and each substation area;

b. The power supply system, (transmission lines, substations, etc.);

c. Distribution lines and components, (line regulators, capacitors, protection devices, etc.);

d. Representative primary voltage drops throughout the system;

e. Planned and/or anticipated new loads, lines, equipment, etc.;

f. Recommended new and carryover construction items within this CWP report; and,

g. Any additional data or information that may be required to describe the system, or describe and justify proposed new construction items.

4.5.2 The first map should show the existing system, with anticipated loads (growth and additions), and (previously anticipated) circuit changes, and resulting primary voltages, at the end of the planning period. The purpose of this map is to clearly describe the system and show anticipated problems at the end of the planning period without proposed new construction items. [see IV-C, Map 1]

4.5.3 The second map should basically contain all of the same information of the first map plus the addition of new proposed construction items and the resulting voltage and other system improvements. The purpose of this map is to show and describe proposed new construction and other proposed changes and show justification for this work in the form of improved primary voltages and/or other system benefits. [see IV-C, Map 2]

4.5.4 The above maps should be drawn neatly, as nearly to scale as possible and utilize accepted standard symbols. A key of the symbols should be shown on the maps.

5. Environmental Reports: As part of the construction work plan, a review of the projects set forth in the CWP report will have to be made to determine if a Borrowers Environmental Report (BER) or other environmental assessment is required. Refer to the Code of Federal Regulations 7 CFR Part 1794 - "Environmental Policies and Procedures", for the requirements.

5.1 Review of CWP amendment projects will also have to be made to determine if a BER or other environmental assessment is required.

6. Construction Work Plan Amendments: A construction work plan amendment will be required for most needed changes to a CWP that has been approved by REA.. Some examples of needed changes to existing CWPs are: increased cost for site-specific projects, increased cost for general category projects and new projects not included in the current CWP. Refer to the CFR for work plan amendment requirements.

7. Approval of Construction Work Plans: Where practical, the CWP should be presented to the REA GFR prior to completing the final draft of the CWP report. The engineer should make arrangements to present the CWP to the system's board of directors and to answer their questions and make modifications as may be deemed necessary. The CWP should be approved by the board of directors by resolution.

7.1 CWP approval authority is delegated to the GFR except in cases where further review and/or approval by the appropriate area office is warranted or required, such as CWPs that contain transmission items. Two copies of the CWP report should be furnished to the GFR who will forward one copy to the area office. REA approval of the construction work plan constitutes general approval for the construction of facilities in the CWP. The CFR sets forth the requirements for specific approval by the GFR or area office prior to the construction of certain facilities.

Exhibit I

19__ - 19__ CONSTRUCTION WORK PLAN

FOR

MODEL RURAL ELECTRIC COOPERATIVE
STATE-##-COUNTY
CITY, STATE

Prepared by:
BORROWER or ENGINEERING FIRM
City, State

Month, Year

(Signatures, as appropriate)

I hereby certify that this 19__ - 19__ Construction Work Plan was prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the State of _____. Registration No. _____

_____ By: _____ SEAL

(Date) (Engineer, P.E.)

MODEL CONSTRUCTION WORK PLAN REPORT

i. Title Page; Engineer's Certification
ii. Table of Contents

I. EXECUTIVE SUMMARY

A. Purpose, Results and General Basis of Study

B. Service Area, Distribution System & Power Supply

C. Summary of Construction Program and Costs

D. Load Table with Changes

II. BASIS OF STUDY AND PROPOSED CONSTRUCTION

A. Design Criteria

B. Distributi on Line and Equipment Costs

C. Status of Previous CWP Items

D. Analysis of Current System Studies

1. 19__ Long-Range Plan

2. 19__ O & M Survey (REA Form 300)

3. Sectionalizing Studies

E. Historical and Projected System Data

1. Annual Energy, Load and Consumer Data

2. Substation Load Data

3. Transformer and Circuit Loads

4. Load Current Measurements

5. Voltage Measurements

6. System Outages and Reliability

III. **REQUIRED CONSTRUCTION ITEMS** [See Note Below]

A. Service to New Customers

B. Service Changes to Existing Customers

C. Distribution Lines - Additions and Changes

D. Substations (Metering Points) - Additions and Changes

E. Sectionalizing Equipment - Additions and Changes

F. Line Regulators - Additions and Changes

G. Ordinary Replacements

H. Other Distribution Items

IV. **APPENDIX**

A. Samples of Computerized Analyses Used

1. Economic Analysis of Alternate Plans

2. Distribution Circuit Analysis Printout

3. Economical Conductor Sizes

B. Letter of Concurrence from Power Supplier

C. System Maps - 19__ Load Levels

1. Map of Projected System Without Changes

2. Map With Proposed New Construction Items

[NOTE: THIS LIST OF REQUIRED CONSTRUCTION ITEMS ONLY INCLUDES THE SAMPLE CATEGORIES COVERED IN THIS MODEL CWP. OTHER CATEGORIES, SUCH AS CAPACITORS, TRANSMISSION LINES, SCADA FACILITIES, NEW

SUBSTATIONS, HEADQUARTERS FACILITIES, ETC. SHOULD BE INCLUDED IN EACH CWP AS APPROPRIATE.]

PURPOSE OF REPORT

This report documents the January 19__ engineering analysis of, and summarizes the proposed construction for, Model Rural Electric Cooperative's (MREC) electric distribution system for the two-year planning period of 19__ and 19__.

The report also provides engineering support, in the form of descriptions, costs and justification of required new facilities, for a loan application to REA to finance the proposed construction program.

RESULTS OF PROPOSED CONSTRUCTION

Upon completion of construction of the facilities proposed herein, the system will provide adequate and dependable service to 8,871 residential/farm consumers using an average of 660 kWH per consumer per month, and 3,802 large power and special loads which are provided for on an individual basis. It is estimated there will be 805 idle services.

GENERAL BASIS OF STUDY

The 19__ projected number of consumers and total peak system load were interpolated directly from the cooperative's 19__ Power Requirements Study (PRS) as approved by REA. The projections were increased slightly to include additional new specific consumers and loads which were not anticipated when the PRS was prepared.

The cooperative's 19__ Long-Range Plan (LRP) load projections and recommendations were reviewed and generally found to be adequate for this two-year planning period. All of the construction proposed herein is consistent with the LRP unless otherwise noted and explained.

The cooperative's 19__ operations and maintenance review, (Review Rating Summary; REA Form 300), was used to determine construction required to replace physically deteriorated equipment and material, upgrade portions of the system to conform with code or safety requirements, and/or improve reliability or quality of service.

New distribution, transmission, and power supply construction requirements were considered simultaneously as a "one system" approach for the orderly and economical development of the total system. All of the proposed construction and recommendations herein, relative to power supply and delivery, were discussed with the cooperative's power supplier, Typical Power Supply Cooperative (TPSC). A copy of a letter dated March 1, 19__, from TPSC concurring with the power supply items herein, is contained in the Appendix of this report.

A complete list of the lines and equipment, and their estimated cost, (all based on recent historical data), required to serve an additional 1,040 members is developed in Section III-A. A similar list and cost of necessary service upgrades to existing members is in Section III-B.

An analysis, using as a basis REA guidelines and the design criteria herein, of thermal loading, voltages, physical conditions and reliability was performed on all of the substations, distribution lines and major equipment of the existing system. <Computer Software Program> was used to analyze the distribution circuits during the appropriate winter or summer 19__ and 19__ transformer peak loading periods. A sample printout is in Section A of the Appendix. The exhibits in Section II form the rest of the basis of this analysis.

For each deficiency that was determined, alternate solutions were investigated and economically evaluated, so that the most cost effective construction, if required, could be proposed. A sample computer analysis used to determine the most economical alternate plans is in Section A of the Appendix.

SERVICE AREA & POWER SUPPLY

Model Rural Electric Cooperative (MREC), whose headquarters are in Small City, provides service in the rural areas of three counties and small portions of two counties in the northwestern portion of State as shown on Map IB-1. The 527 square mile service area is comprised mostly of rolling, forested hills and has several small lakes. MREC's service area surrounds Large City, (1990 population of 15,150), which has its own electric system.

Most of the economy of this area is based on commercial services for the tourist industry and agriculture, in particular truck farming. The cooperative serves 65 oil wells, however oil production in the area is declining. MREC has and will continue to serve the moderate growth of new commercial, small manufacturing and residential consumers adjacent to Large City. The rural areas are not increasing in population.

The following data is from Model's 12/31/__ REA Form 7:

Number of Consumers:	11,633	
MWH Purchased:	110,055	
MWH Sold:	101,628	
Maximum kW Demand:	20,869	
Total Utility Plant:	$12,272,815	($1, 055/member)
Consumers/mile:	9.34	

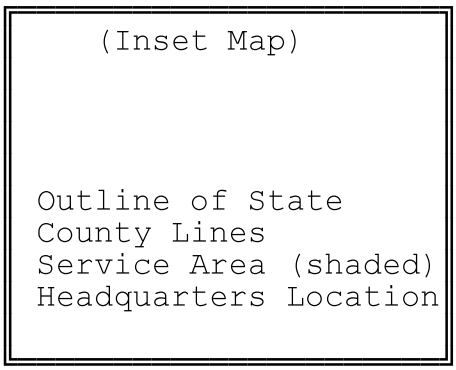
Each of the 21 primary distribution circuits (1 is single-phase), totaling 1,245 miles, is constructed for and operated at 7,200/12,470 volts, grounded wye. Installed conductor sizes range from #11 copper to #4/0 ACSR. Nearly 40 percent of the facilities now in service were installed prior to 1960.

Typical Power Supply Cooperative (TPSC) provides all of power and energy needs to Model Rural Electric Cooperative, plus 8 other distribution cooperatives, (see Map IB-2), by virtue of a standard "all requirements" contract. TPSC is a REA financed G & T cooperative with offices in Bigger City, State.

TPSC constructs, owns, operates and maintains the five distribution substations, plus one now under construction, and the 102 miles of 69,000 volt transmission lines which supply MREC's distribution system.

MREC also receives power, up to a 5,000 kVA contract limit, from Jackson Substation, owned by Large City Electric

Company, who contractually wheels the power to MREC from TPSC.



MREC SERVICE AREA
STATE

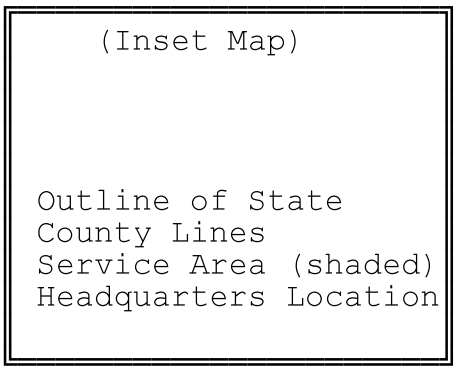
Model CWP: Map IB-1

MODEL RURAL ELECTRIC COOPERATIVE
SERVICE AREA

(County Lines)
(Headquarters Location)
(District Headquarters)
(Outline of Service Area)
(Substation Names and Locations)
(Transmission Lines and Voltages)
(Outline of Substation Areas)
(Large Cities and Villages)
(Important Roads)
(Large Lakes and Rivers)

Model CWP: Map 1B-2

TYPICAL POWER SUPPLY COOPERATIVE
SERVICE AREA



TPSC SERVICE AREA
STATE

(Headquarters Location)
(District Headquarters)
(Service Areas of Distribution Coops)
(County Lines)
(Generating Stations and Delivery Points)
(Transmission Lines and Voltages)
(Major Substation Names and Locations)
(Important Cities, Roads, Lakes and Rivers)

AVAILABLE IN HARD COPY ONLY

AVAILABLE IN HARD COPY ONLY

(NOTE: THE FOLLOWING SAMPLE DESIGN CRITERIA IS SHOWN FOR EXEMPLARY PURPOSES ONLY. IT IS NOT MEANT TO BE INCLUSIVE OF ALL CRITERIA THAT CAN OR SHOULD BE USED, NOR IS EACH ITEM BELOW NECESSARY FOR EVERY SYSTEM. PRIOR TO DEVELOPING THE CWP, THE ENGINEER SHOULD DEVELOP A COMPLETE DESIGN CRITERIA RELATIVE TO THE SPECIFIC SYSTEM BEING ANALYZED.)

DESIGN CRITERIA

Each of the following design criteria items was reviewed and concurred by the REA General Field Representative on _____, 19__ .

Construction proposed herein is required to meet the following minimum standards of adequacy for voltages, thermal loading, safety and reliability on the system.

1. The maximum voltage drop on primary distribution lines not to exceed 8 volts, (120 volt base), after re-regulation.

2. The following equipment not be thermally loaded by more than the percentage shown of its nameplate rating:
   __% Power Transformers
   __% Substation and Line Voltage Regulators
   __% Oil Circuit Reclosers
   __% Line Fuses

3. Primary conductors not to be loaded over __% of their thermal rating. (__% for major tie lines between substations.)

4. Poles and/or crossarms to be replaced if found to be physically deteriorated by visual inspection and/or tests. (Ordinary Replacements)

5. Conductors (and associated poles and hardware as required), to be replaced if found to contain an average of over __ splice(s) per phase per span in one mile increments or if conductor is old, in poor condition and has excessive sag.

6. Primary distribution lines to be rebuilt and/or relocated if they are found to be unsafe or in violation (when constructed) of the National Electrical Safe Code or other applicable code clearances .

DESIGN CRITERIA (cont.)

7. System improvements to be considered, and made if necessary, in specific areas where members have experienced more than __ outage hours per year, excluding outages caused by major storms or the power supplier, for the last __ consecutive years.

8. New lines and line conversions to be built according to the standard primary voltage levels as recommended in the 19__ Long Range Plan.

9. New primary conductor sizes to be determined on a case by case bases using the <Economic Conductor Sizing Computer Program> and presently known constants and variables. The final proposed conductor may be modified to conform with the cooperative's standard sizes and recommendations of the Long-Range Plan.

10. All new primary construction to be overhead except where underground is required to comply with governmental or environmental regulations, local restrictions or favorable economics.

11. All new transmission and distribution lines to be designed and built according to REA standard construction specifications and guidelines.

NOTE: It is recommended that proposed construction items required for voltage improvements, whose forecast need is based solely on calculated voltages from computerized circuit analysis printouts, not be authorized for construction until such calculated voltages are measured in the field and extrapolated to peak loading periods, and then compared to calculated values to corroborate that actual voltages are below the above minimum design levels.

DISTRIBUTION LINE AND EQUIPMENT COSTS

19__ Est Cost $ / mile	DISTRIBUTION LINES
	NEW TIE LINES
14,000	1 - Phase; OH, #2 ACSR *
17,000	1 - Phase; OH, #1/0 ACSR *
24,500	1 - Phase; UG, #1/0 AL *
28,000	3 - Phase; OH, #2 ACSR
37,000	3 - Phase; OH, #1/0 ACSR **
49,000	3 - Phase; OH, #4/0 ACSR **
69,500	3 - Phase; UG, #1/0 AL *
	1-PHASE TO 3-PHASE (OH) LINE CONVERSIONS
42,000	With #1/0 ACSR *
52,000	With #4/0 ACSR
	3-PHASE TO 3-PHASE (OH) LINE CONVERSIONS
45,000	With #1/0 ACSR **
54,000	With #4/0 ACSR
65,000	With 336,400 cm ACSR **

NOTES

* Based on 19__ actual cost of materials and force account labor.

** Baed on 19__ "830 construction contract" (un it prices) using contractor furnished labor and equipment.

- Above costs include engineering (15%) and tree trimming ($1,900 per mile).
- All costs are inflated 5% per year from the year actual construction was performed.

($)	DISTRIBUTION EQUIPMENT (INSTALLED COST)
	LINE REGULATORS
4,200	1 - 50 Amp
13,500	3 - 50 Amp
17,000	3 - 100 Amp
	CAPACITORS
2,800	3 - 100 kVAR
	OIL CIRCUIT RECLOSERS
	(See Section III-E, Page 2)

NOTES

All above equipment cost based on 19__ actual cost of materials, force account labor and include engineering and overheads.

AVAILABLE IN HARD COPY ONLY

ANALYSIS OF 19__ LONG-RANGE PLAN

Model Rural Electric Cooperative's 19__ Long-Range Plan (LRP) was prepared by Consulting Engineers Inc. of Another City, State in the spring of 19__. It was approved by REA in June of that year.

The study was based on the 19__ winter peak loads of 18,516 kW and an average annual load growth rate of 4.0 percent. Two future load levels were studied: 19__ when the loads would be increased by approximately 80%, and 19__ when the loads would be approximately 165% more than the base year.

The LRP recommends that the distribution system continue to be built and operated at 7.2/12.47 kV throughout the entire planning period. Alternate plans which were developed but found not to be the most economical were conversions of the entire system and portions of the system to 14.4/24.9 kV operation. The LRP also recommends that all of the substations be interconnected with #4/0 ACSR feeders by the end of the "intermediate" load level period.

A separate but related study on the 69 kV transmission and distribution substation supply system was also performed at the same time. The LRP recommends continuation of the 69 kV system with upgrades as needed. The plan also calls for the installation of two new distribution substations when required by the area loads. (It is noted that one of these substations, Kennedy Substation, is presently under construction).

The MREC system loads have grown more rapidly than projected by the LRP. They are now expected to grow at approximately 5.0% according to the present Power Requirements Study, which is slightly higher than the LRP projections.

The following table, (II-D1, page 3), compares the LRP projected loads with actual loads experienced and the present PRS load forecast. The total system peak loads are now expected to be 12.6 and 21.1 percent higher, respectively, than the LRP projections for the end of this CWP planning period and the LRP intermediate load level periods. The presently projected load increases are not large enough to invalidate the conclusions and recommendations of the current LRP and its associated power supply study. Thus, the 19__ LRP can be used as a basis for recommendations in this CWP with the following exception.

Within the LRP is a computerized economical conductor sizing study and recommendations. The following input factors to that study have significantly changed; area growth rates, cost of wholesale power and energy, interest rates of borrowed money and the rate of inflation. Therefore, the recommendations are no longer valid and future decisions regarding conductor sizes, including recommendations in this CWP, must be based on a study using more current data.

The unexpected load increases are attributed to; population and load growth in the Adams, Jefferson, Lincoln and Truman Substation areas which surround Large City, average monthly residential energy usage has increased to 660 kWH from the LRP projection of 590 kWH, and service to three new large commercial consumers.

The existing LRP may or may not be valid for the next CWP. If loads continue to increase unexpectedly, especially within the "suburban" substation areas named above, it is recommended that a new LRP be prepared before the next CWP. In addition, by the next CWP period, the existing LRP will be seven years old. Also, over fifty percent of the installed distribution facilities will be over thirty-five years old and a large portion of them will need to be replaced because of physically deteriorated conditions.

AVAILABLE IN HARD COPY ONLY

ANALYSIS OF 19__ OPERATIONS AND MAINTENANCE SURVEY

In August and September of 19__, MREC field inspected all of the distribution facilities in 32, one and one-half mile line sections of the distribution system. The inspected facilities were summarized (with the aid of a computer) and analyzed. A report was made of the analysis and results of that survey. This survey, as well as other data such as monthly substation reports, monthly outage reports, and equipment maintenance records were used as a basis for completing REA Form 300, Review Rating Summary. The O & M survey and the REA Form 300 was reviewed by the Board of Directors and the REA GFR. Two copies of the survey report and Form 300 were furnished to REA in November, 19__.

The above survey, analysis and reports are used as the bases for the following conclusions and recommended CWP construction items.

In general, the overhead and underground distribution facilities were found to be in satisfactory condition. Likewise, nearly all of the operations and maintenance, and engineering programs were found to be satisfactory with some exceptions as noted on the report.

It is recommended to continue the program of testing approximately 2,700 poles per year. Historically, it has been determined that approximately 1.3 percent of the poles tested are found to be physically deteriorated and need to be replaced. The cost to replace these poles is contained in Section III this CWP under "Ordinary Replacements".

The cooperative has a program to clear and/or widen its overhead distribution line rights-of-ways on a seven year cycle. This requires the clearing of approximately 120 miles of rights-of-ways each year by a contracted tree trimming company. Of this total, approximately 20 miles are widened annually from 20 feet to a 30 foot right-of-way. Based on the survey performed and a thorough analysis of the system, it is recommended to continue this program. The estimated cost for this program is also in Section III of this report.

SECTIONALIZING STUDIES

MREC no longer performs sectionalizing studies on a system-wide basis. Each year the Engineering Department analyzes the protection schemes of one-third of the system's distribution circuits, and all new or significantly changed circuits due to CWP projects or other major construction.

Upon completion of the above studies, a list is made of OCRs, fuses and other devices required to adequately protect the circuits investigated. This list of protection equipment additions and changes, and its estimated installed cost, required for the next planning period is included in Section III-E of this CWP report.

In addition to the above new protection requirements, annually, one-third of the system's OCR's are removed, inspected, maintained, (cleaned and oil changed), tested and re-installed.

Copies of the data, calculations and final results of the above circuit protection studies are filed in MREC's Engineering Department. Also retained are MREC's OCR maintenance and test reports.

AVAILABLE IN HARD COPY ONLY

AVAILABLE IN HARD COPY ONLY

AVAILABLE IN HARD COPY ONLY

AVAILABLE IN HARD COPY ONLY

AVAILABLE IN HARD COPY ONLY

AVAILABLE IN HARD COPY ONLY

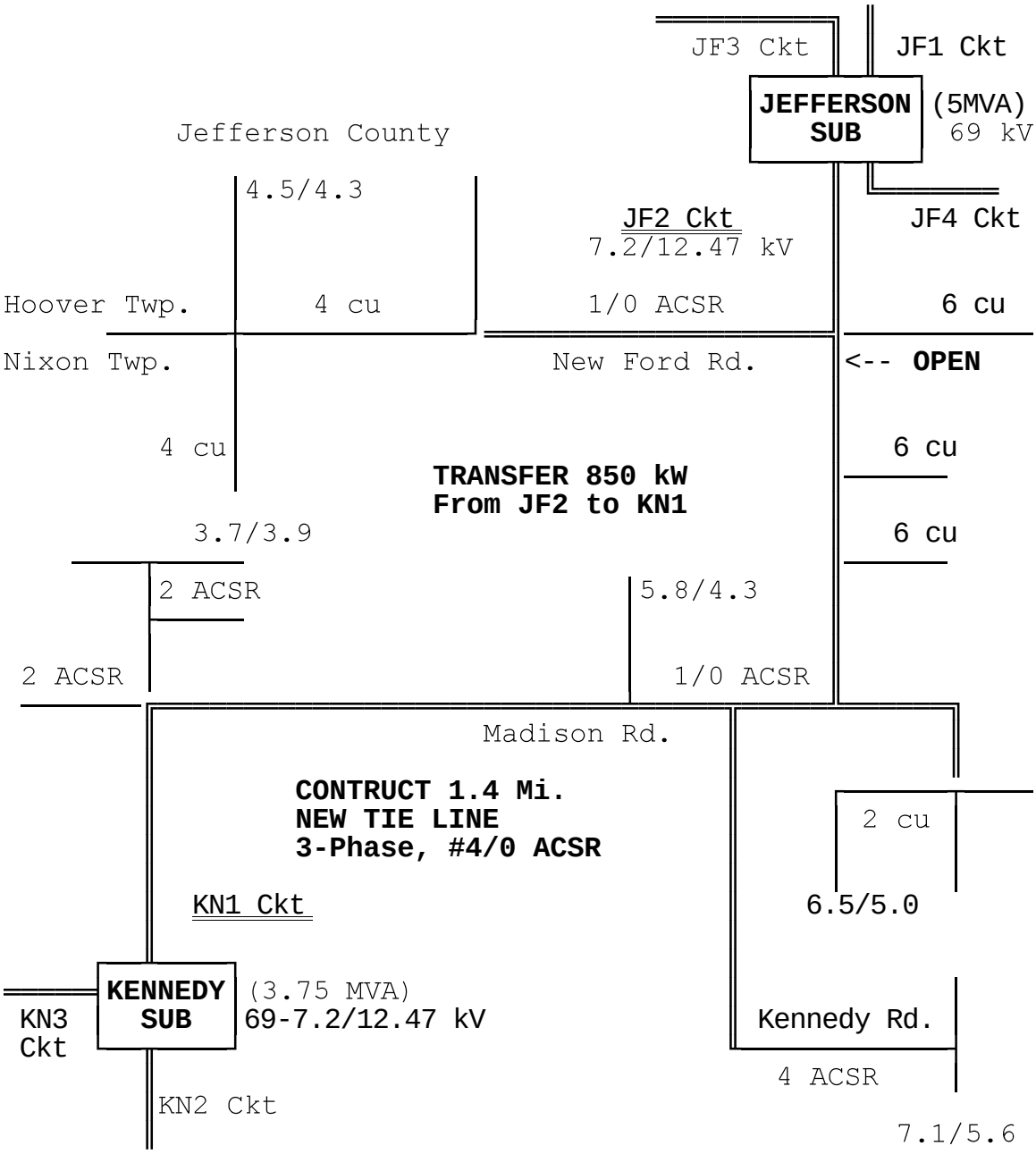
AVAILABLE IN HARD COPY ONLY

AVAILABLE IN HARD COPY ONLY

AVAILABLE IN HARD COPY ONLY

AVAILABLE IN HARD COPY ONLY

Model CWP: III-C
Map C1
CWP ITEM: JF2-1



Scale: 1" = 1 mile

KEY

═══	3-phase OH Dist. Line
───	1-phase OH Dist. Line
(xx.x/x.x)	Primary Voltage Drop

MODEL RURAL ELECTRIC COOPERATIVE

(Before/After Load Transfer)

NEW DISTRIBUTION CONSTRUCTION ITEM - NEW TIE LINE

YEAR: 19__ CWP ITEM NUMBER: **JF2-1**
CFR CODE: 201 ESTIMATED COST: **$78,400**

DESCRIPTION OF PROPOSED CONSTRUCTION

Construct a new 1.4 mile, 3-phase, #4/0 ACSR conductor tie line along Madison Road from the Jefferson #2 South Circuit to the Kennedy #1 North Circuit and transfer approximately 850 kW of load from Jefferson to the new Kennedy Substation.

REASON FOR PROPOSED CONSTRUCTION

The above work is required to provide thermal loading relief to the 5 MVA Jefferson Substation transformer which is projected to be loading 494 kW (10%) over nameplate in 19__.

RESULTS OF PROPOSED CONSTRUCTION

1. As a result of the above work, the Jefferson substation transformer will not be loaded over its nameplate rating in accordance to design criteria #2.

2. This work is consistent with the Long-Range Plan of using the new Kennedy Substation to provide load relief to adjacent substations and to tie all the substations together with #4/0 ACSR feeders

3. This work will also slightly improve this area's primary distribution voltages, (approximately 1.5 volts), and decrease area peak load losses by about 3.2 kW, ($650 average annual savings).

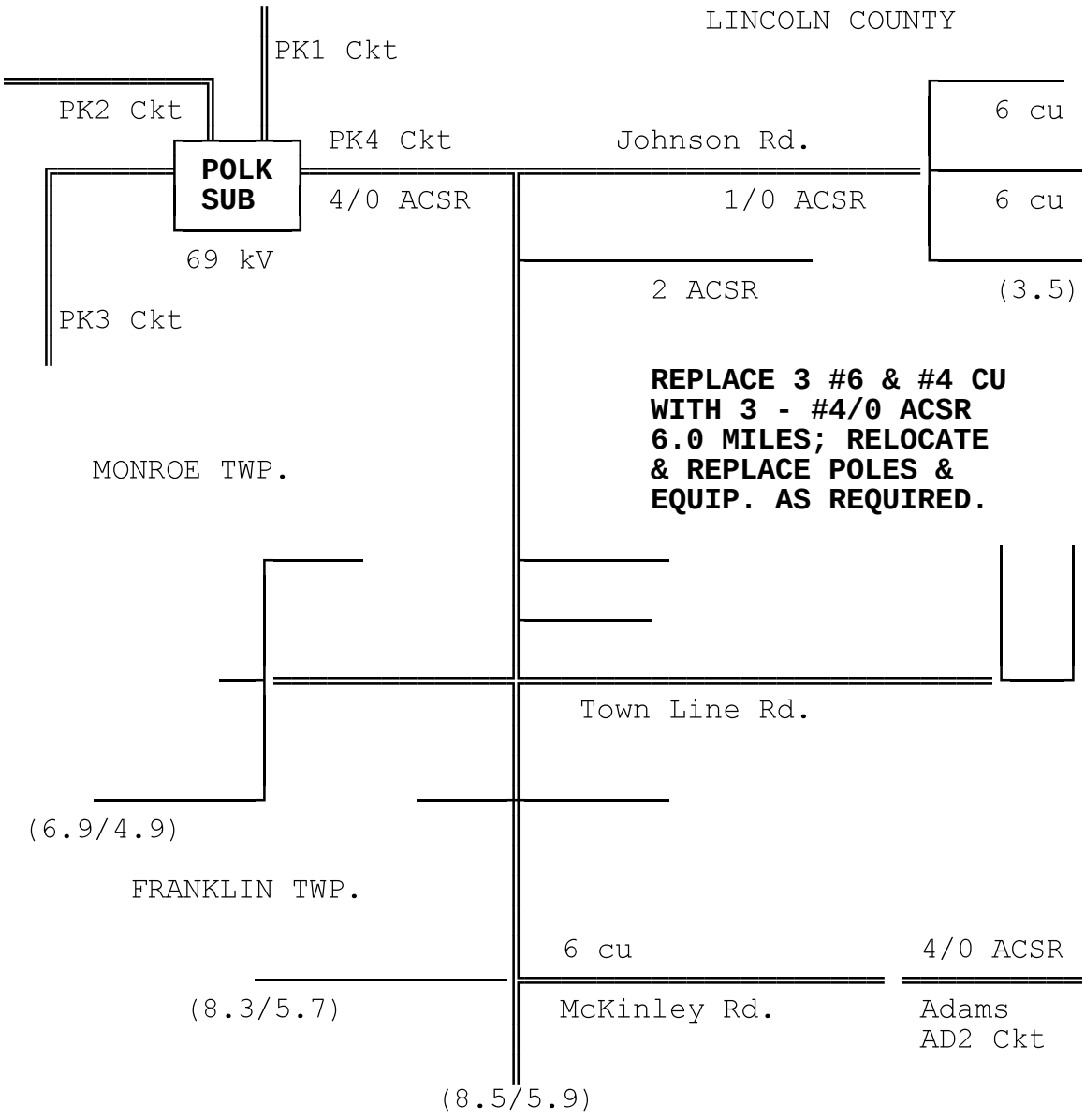
ALTERNATE CORRECTIVE PLANS INVESTIGATED

1. Replace the Jefferson 5 MVA transformer with a new 7.5 MVA transformer ($90,000) in 19__.
   Results: A present worth economic analysis shows that this plan costs approximately $15,000 more after 5 years and $62,000 more after 30 years. Also, this plan is not consistent with the LRP.

2. Add fans ($12,000) to the Jefferson transformer in 19__ and defer the recommended construction above ($78,400) by 3 years.
   Results: A present worth economic shows that this plan is more economic in the first years of the plan, approximately $15,800 after 5 years; but after 15 years

this alternate plan is more costly ($10,000 after 30 years), and is not consistent with the LRP.

Model CWP: III-C
Map C2
CWP ITEM: PK4-1



POLK - PK4 Circuit
7.2/12.47 kV

Scale: 1" = 1 mile

KEY

3-phase OH Dist. Line

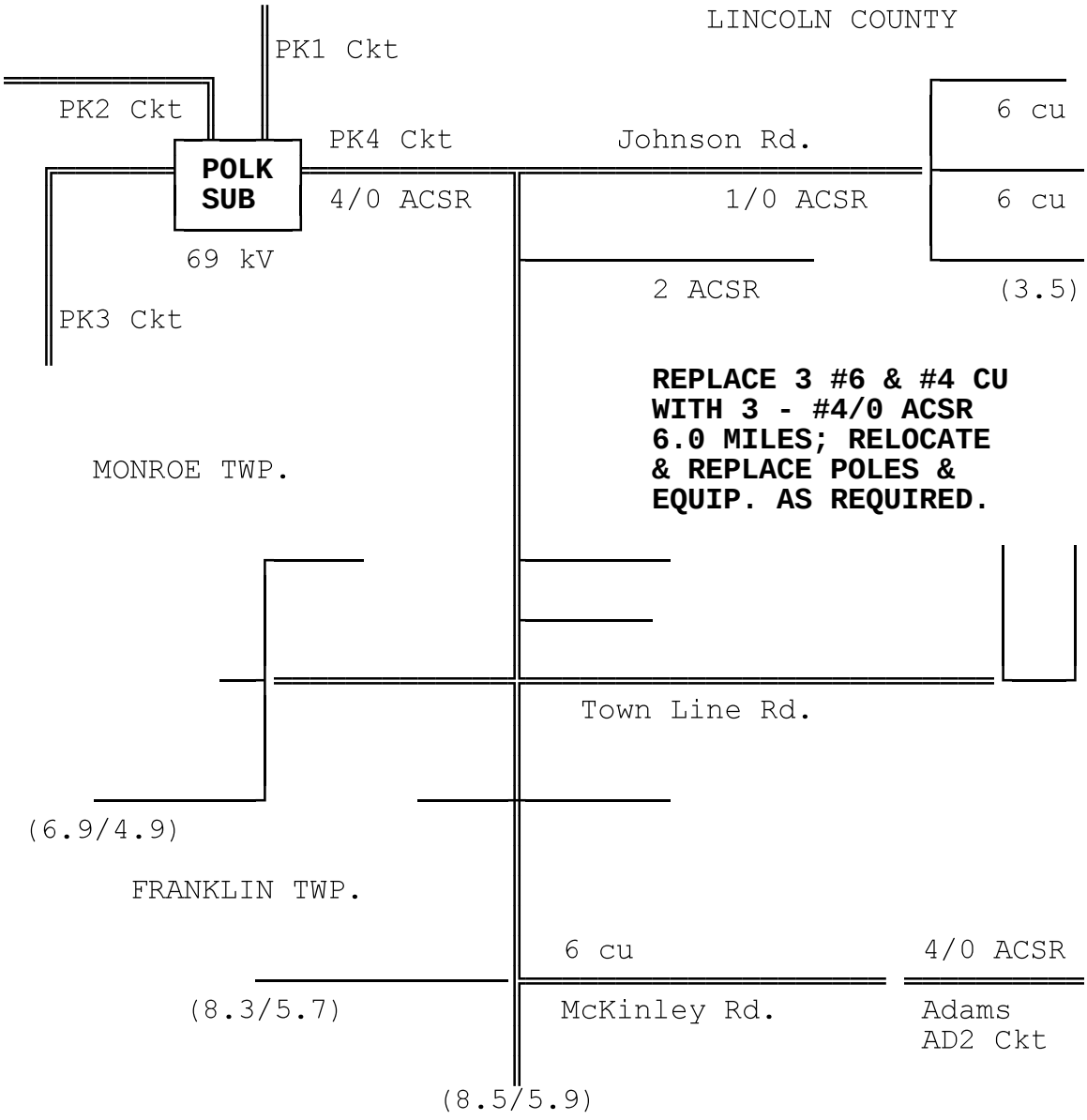
MODEL RURAL

(xx.x/x.x)

1-phase OH Dist. Line
Primary Voltage Drop
(Before/After Line Conversion)

ELECTRIC COOPERATIVE

Model CWP: III-C
Map C2
CWP ITEM: PK4-1



POLK - PK4 Circuit
7.2/12.47 kV

Scale: 1" = 1 mile

KEY

═══	3-phase OH Dist. Line
───	1-phase OH Dist. Line
(xx.x/x.x)	Primary Voltage Drop

MODEL RURAL ELECTRIC COOPERATIVE

(Before/After Line Conversion)

NEW DISTRIBUTION CONSTRUCTION ITEM - LINE CONVERSION

YEAR: 19__ CWP ITEM NUMBER: **PK4-1**
CFR CODE: 302 ESTIMATED COST: **$315,000**

DESCRIPTION OF PROPOSED CONSTRUCTION

Replace 6.0 miles, along Jackson and McKinley Roads, of the Polk #4 Circuit, (PK-4E), consisting of various 3-phase, copper conductors, with #4/0 ACSR conductor. Replace poles and equipment and relocate portions of line as required.

REASON FOR PROPOSED CONSTRUCTION

The above work is required to improve primary voltage drops to within design criteria limits; also to improve safety, losses and reliability in the area. This work is part of the circuit strengthening program recommended in the LRP.

RESULTS OF PROPOSED CONSTRUCTION

1. As a result of this work, the maximum primary voltage drops at the extremities of this circuit will be 5.9%, an improvement of 2.6%. Circuit losses will also improve by 4.8 kW (16,750 kWH; $3,300 per year).

2. This portion of line was built in 1957. A recent survey shows that 35 (28%) of the poles on this line are physically deteriorated and that the primary conductor has over 120 splices. Eleven homes have been built under this line. Large portions of the line were built across fields, hundreds of feet away from the road. Rebuilding and relocating this line will correct the above problems and make the line more accessible from the road for faster and easier patrolling and repair, and thus improve reliability.

3. This portion of line is part of the main circuit tie between Polk and Adams Substation. Upon completion of this work, these two substations will be able to provide approximately 40% back-up capabilities to each other during a major outage.

ALTERNATE CORRECTIVE PLANS INVESTIGATED

The present worth economics of an alternate plan to temporarily install line regulators, and spread the above proposed construction equally over a three year period was investigated and found to slightly (approximately 5%) less

costly. It is not recommended to delay this construction because of the urgency of the above problems identified.

NEW DISTRIBUTION SUBSTATION ITEM - ADD FANS

YEAR: 19__ CWP ITEM NUMBER: **LN-1**
CFR CODE: 5XX ESTIMATED COST: **$12,500**

DESCRIPTION OF PROPOSED CONSTRUCTION

Install fans on the 5,000 kVA power transformer at Lincoln Substation to increase its capacity to 6,250 kVA.
Note: This substation item will be included in Typical Power Supply Cooperative's (TPSC) next construction work plan.

REASON FOR PROPOSED CONSTRUCTION

The above work is required to provide thermal loading relief to the 5 MVA Lincoln Substation transformer which is projected to be loading 233 kW (4.7%) over nameplate in 19__.

RESULTS OF PROPOSED CONSTRUCTION

As a result of the above work, the Lincoln Substation transformer is not expected to be loaded over its new nameplate rating, in accordance to design criteria #2, until 19__. This work is consistent with the Long-Range Plan.

ALTERNATE CORRECTIVE PLANS INVESTIGATED

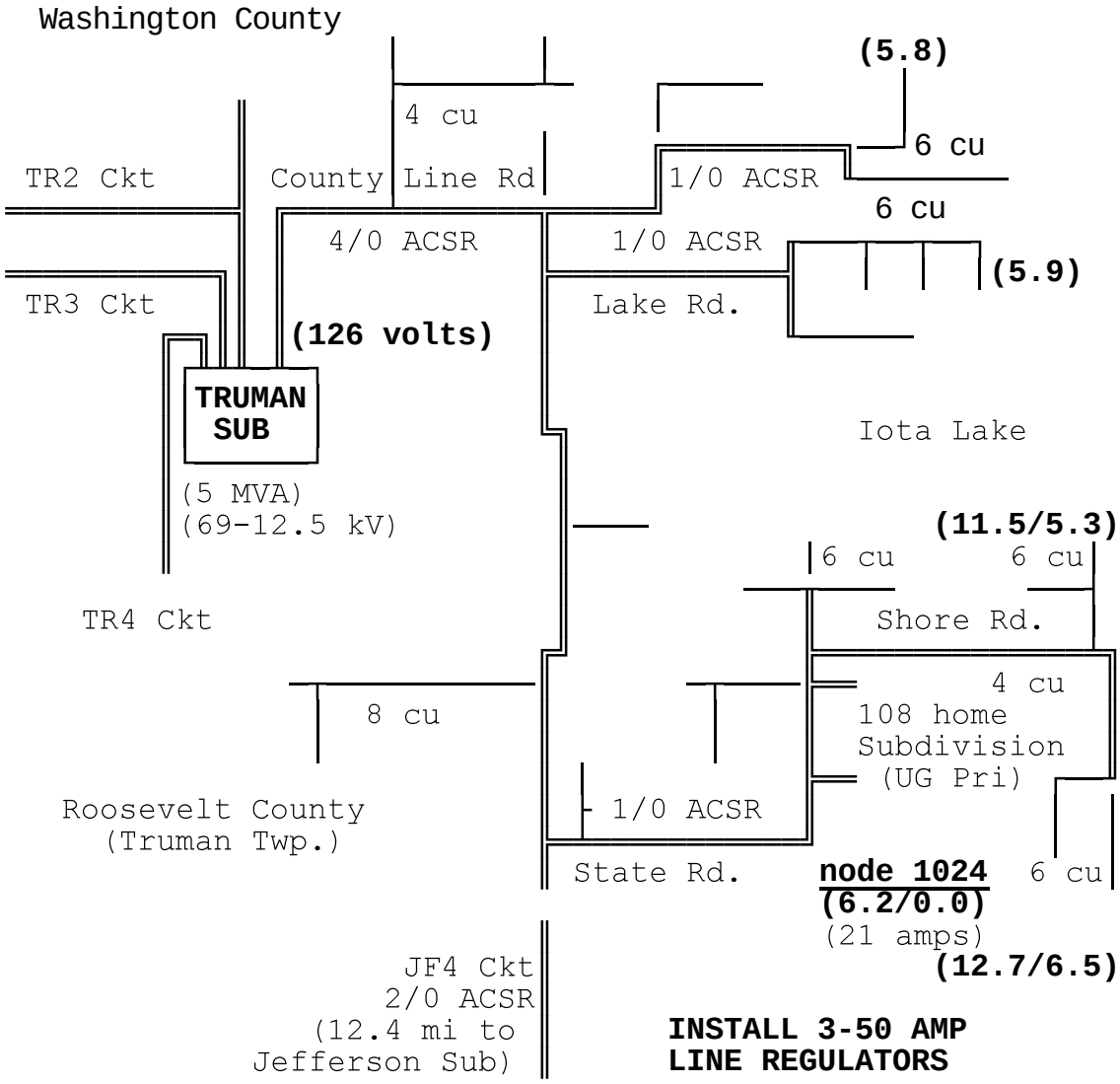
1. Replace the Lincoln 5 MVA transformer with a new 7.5 MVA transformer ($90,000) in 19__.
   Results: A present worth economic analysis shows that this plan costs approximately $15,000 more after 5 years and $62,000 more after 30 years. Also, this plan is not consistent with the LRP.

2. Construct a new, 1.8 m ile, 3-phase tie line ($89,000) and transfer approximately 840 kW from the LN2 Circuit to the JK1 Circuit.
   Results: A present worth economic shows that this is not an economical viable plan and is not consistent with the LRP.

AVAILABLE IN HARD COPY ONLY

AVAILABLE IN HARD COPY ONLY

Model CWP: III-F
Map F1
CWP ITEM: TR1-2



Truman - TR1 Circuit
(7.2/12.47 kV)

Scale: 1" = 1 mile

KEY

═══	3-phase OH Dist. Line
───	1-phase OH Dist. Line
(xx.x/x.x)	Primary Voltage Drop (Before/After Regulation)

MODEL RURAL ELECTRIC COOPERATIVE

NEW DISTRIBUTION CONSTRUCTION ITEM - REGULATORS

YEAR: 19__ CWP ITEM NUMBER: **TR1-2**
CFR CODE: 604 ESTIMATED COST: **$17,000**

DESCRIPTION OF PROPOSED CONSTRUCTION

Install three, new, 50 amp, 7.2 kV, line voltage regulators near circuit node 1024 on the Truman Substation, TR1 Circuit. This location is on State Road, 7.5 circuit miles from the substation. The projected 19__ voltage drop and current at this node will be 6.2 volts and 21 amps.

REASON FOR PROPOSED CONSTRUCTION

Work is required to improve the voltage to approximately 150 members located at the extremities of this circuit to within 8 volts drop as per Design Criteria #1. The calculated maximum uncorrected voltage drop on this circuit will be 12.7 volts. Note; the existing calculated voltages on this circuit are within 2 volts of the voltage readings of the mini-max meters installed on this circuit.

RESULTS OF PROPOSED CONSTRUCTION

1. The maximum voltage drop on TR1 Ckt will be 6.5 volts

2. This work will defer $120,000 of line conversion for 4 years for a savings of $12,670 in 19__; $14,300 at the end of 30 years.

3. This work is consistent with the Long-Range Plan.

ALTERNATE CORRECTIVE PLANS INVESTIGATED

1. Install line switches ($2,000) and transfer 450 kW to JF4 Circuit.
   Results: Voltage drops on JF4 will be over 8 volts.

2. Construct new, 3-phase, 1.8 mile tie line along Shore Road ($72,000) and transfer 420 kW to AD3 Circuit.
   Results: More costly; will overload AD3 line regulators; not consistent with LRP

3. Convert 3.0 miles to 3-phase, #4/0 ACSR ($120,000)
   Results: Would improve voltages, losses and reliability; consistent with LRP; required in 19__.
   Deferring this work is more economical as explained above and shown in Appendix A, pages 1 and 2.

ORDINARY REPLACEMENTS - POLES

CFR CODE: 606 ESTIMATED COST: **$33,600**

DESCRIPTION OF PROPOSED CONSTRUCTION

Replace all poles found to be physically deteriorated (condemned) by MREC's contracted pole inspectors and own personnel throughout the system. It is estimated that approximately 40 poles per year will need to be replaced.

REASON FOR PROPOSED CONSTRUCTION

MREC hires Contractor Pole Inspection Company to inspect one-eighth, approximately 2,700, of the cooperative's poles each year. Historically, approximately 1.3%, or 35 of these inspected poles need to be replaced because of their poor physical condition. In addition, the cooperative's personnel find an average of an additional 5 such poles each year that need to be replaced. The pole inspection program and results are further documented in MREC's O & M survey and on REA Form 300.

ESTIMATED COST - REPLACE POLES

	2 Yr Avg 19__-__	Est. 24 Mo. CWP Period 19__	19__	TOTAL
Number of Pole Replacements:	40	40	40	80
Average Cost/Pole (1):	$392	$410	$430	$420
TOTAL ESTIMATED COST:	$15,680	$16,400	$17,200	$33,600

(1) Total installed cost less original cost of property replaced.

OTHER DISTRIBUTION ITEMS

CFR CODE: 700 ESTIMATED COST: **$137,200**

DESCRIPTION AND REASONS FOR PROPOSED CONSTRUCTION

1. Annually install approximately 200 outdoor yard (security) lights and associated poles as requested by consumer-members. This work is necessary because of the cooperative's outdoor lighting sales program initiated in 19__.

2. Annually widen approximately 20 miles of MREC's distribution line rights-of-ways (ROW) from 20 feet to 30 feet wide. MREC contracts out all of it's ROW clearing and tree trimming. The contractors clear approximately 120 linear miles per year of which approximately one-sixth was originally cleared to, and subsequently maintained at a 20 foot width. MREC's criteria is to maintain a 30 foot cleared ROW for all overhead distribution lines. The estimated additional cost, based on previous actual costs, to widen the existing ROW's to 30 feet is $1,880 per mile.

ESTIMATED COST - INSTALL YARD LIGHTS

	2 Yr Avg 19__-__	Est. 24 Mo. CWP Period 19__	19__	TOTAL
(CFR CODE 701)				
Number of New Lights	200	200	200	400
Average Cost/Light:	$140	$150	$160	$155
TOTAL ESTIMATED COST:	$28,000	$30,000	$32,000	$62,000

ESTIMATED COST - WIDEN RIGHTS-OF-WAYS

	2 Yr Avg 19__-__	Est. 24 Mo. CWP Period 19__	19__	TOTAL
(CFR CODE 702)				
Number of Miles	20	20	20	40
Average Cost/Mile:	$1,840	$1,860	$1,900	$1,880
TOTAL ESTIMATED COST:	$36,800	$37,200	$38,000	$75,200

AVAILABLE IN HARD COPY ONLY

AVAILABLE IN HARD COPY ONLY

AVAILABLE IN HARD COPY ONLY

AVAILABLE IN HARD COPY ONLY

AVAILABLE IN HARD COPY ONLY

August 7, 19

TYPICAL POWER SUPPLY COOPERATIVE

Mr. , General Manager
Model Rural Electric Cooperative
P.O. Box
City, State

Dear :

This refers to action item 1 of the minutes to the power supply meeting held on May 28, among you, Model Rural Electric Cooperative (MREC), and Typical Power Supply Cooperative (TPSC).

TPSC's one-ownership report on the engineering economy study presented by you for constructing the BIG 161 kV substation has been completed. Several questions about the study were discussed and resolved during the power supply meeting.

A consensus was reached among all parties that the construction of the BIG 161 kV Substation by the spring of 1994 is the most economical solution to the long-term loading problem at the LITTLE 161 kV substation. TPSC would install a 161 kV tap point and switches in the LITTLE North-SMALL 161 kV Transmission Line and construct a 2 mile, 161 kV tapline to the BIG 161 kV Substation site. The tentative in-servcie date for the project is April 1, 1994.

We have initiated a project to complete this work. Of course, this project is subject to TPSC's customary capital project approval process. We expect its approval for the expenditures as planned.

We are pleased to report on this matter and will keep you informed of our progress. If you have any questions, please let us know.

Sincerely,

Manager, Typical Power Supply Cooperative

MODEL RURAL ELECTRIC COOPERATIVE SYSTEM

CWP - 19__ (Future) LOAD LEVELS
(Without Proposed New Construction)

INCLUDE FOLLOWING:

Service Area, Headquarters
Substations and Substation Areas
Transmission Lines, Power Supplies
Distribution Lines, Phasing
Line Regulators, Capacitors, Voltmeters
* OCRs, Switches, Fuses
** Primary Voltage Drops (Before/After Regulation)
** Distances from Substation
Planned/Anticipated New Loads, Lines & Equipment
Important Cities, Roads, Lakes and Rivers
Key of Symbols Used
Scale, Date, Engineer

NOTES
* Include as required or appropriate
** Shown at representative and critical locations

(The purpose of this map is to show the system and anticipated problems at the end of the planning period before proposed new construction items.)

MODEL RURAL ELECTRIC COOPERATIVE SYSTEM

CWP - 19__ (Future) LOAD LEVELS
(With Proposed New Construction Items)

INCLUDE FOLLOWING:

Service Area, Headquarters
Substations and Substation Areas
Transmission Lines, Power Supplies
Distribution Lines, Phasing
Proposed New and Carryover CWP Construction Items
Line Regulators, Capacitors, Voltmeters
* OCRs, Switches, Fuses
** Primary Voltage Drops (Before/After Regulation)
** Distances from Substation
Planned/Anticipated New Loads, Lines & Equipment
Important Cities, Roads, Lakes and Rivers
Key of Symbols Used
Scale, Date, Engineer

NOTES
* Include as required or appropriate
** Shown at representative and critical locations

(The purpose of this map is to show the system, proposed new and carryover CWP construction items, and the anticipated results (e.g. improved primary voltages) as a result of the proposed new construction items.)

Model CWP: IV-D

MODEL REC SYSTEM MAP WITH PROPOSED CONSTRUCTION ITEMS

(VOLTAGE DROPS AT PEAK 19__ LOAD LEVELS)